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ABSTRACT

A sociometric survey examined the informal faculty development network existing within the School of Nursing at East Tennessee State University. During the fall 1983 semester, all 25 nursing faculty members at the school were asked to complete a self-report instrument dealing with patterns of seeking and providing advice regarding their role as a teacher. Multidimensional scaling and cluster analysis techniques were used to uncover the latent or emergent structure of a faculty development network at the school. It was concluded that little informal sharing of information existed between members of the associate and baccalaureate degree programs. New faculty members appeared to linger at the fringes of the faculty development networks and therefore did not have access to suggestions from colleagues. Part-time faculty members were more likely to act as isolates in the teaching development network. The principle of homophily seemed to be operating, as faculty members selected others with whom to interact concerning professional development. Those members who were alike in terms of years since graduate school tended to cluster together. The results of this study were seen as demonstrating the utility of the techniques of multidimensional scaling and cluster analysis in a research study of this nature. (MN)

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ANALYZING THE STRUCTURE OF AN INFORMAL FACULTY DEVELOPMENT NETWORK IN A SCHOOL OF NURSING

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BACKGROUND

Structural analysis refers to a generalized approach for describing and analyzing the social structure of groups which vary in terms of diversity and complexity. Structural analysis begins with the assumption that all groups contain structure, be it formal or informal and that this structure determines the access that individuals or institutions will have to valued resources such as information, wealth and power. Rogers and Agarwala-Rogers (1976) state that the importance of group structure is evidenced by the system effect; i.e., the influence of others in a system on the behavior of an individual member. Schwartz and Jacobson (1980) further state that an organization is comprised of relatively stable networks through which messages flow that affect the productivity and maintenance of the system. Because a strong relationship exists between the effect of the groups (networks) within the organization (system) and the effect of the system on the individual, then analyzing the networks comprising an organization would be valuable in mobilizing and utilizing the individual resources available to the organization.

There are two predominant types of groups that exist within most organizations; 1) the prescribed groups; i.e., departments and work groups, or 2) emergent groups; i.e., coalitions or cliques. Many types of social relationships exist simultaneously within an organization (Tichy and Fombrun, 1979). A structural analysis of an organization must consider both types of groups in order to fully understand the communication flow within the organization. The prescribed groups are easily identified by the organizational chart, but the emergent groups are less obvious. However, emergent groups can be identified by analyzing communication patterns. The emergent group relations have been found to be systems for making decisions, concealing or transmitting information and mobilizing resources (Lincoln and Miller, 1979).

An understanding of the structure in a particular network will allow researchers to effectively explain behaviors and actions at an individual level. Tichy and Fombrun (1979) describe three levels of network analysis; 1) overall network structure, 2) clusters within the network, and 3) individual attributes within the network. The latter two levels will be the focus of this research. By examining the individual or personal communication network, the communication links between members in a network can be identified and individual communication roles can be ascertained. Knowledge of the emergent system and communication flow can aid in the diffusion of information and

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ideas within the organization. Becker (1970) suggests that knowledge of communication networks allows change agents to identify points where desirable innovation or change could be effectively introduced into an organization. Fine & Kleinman (1983) reported that by examining how individuals perceive their social network, individual interpretations of constraints and expectations of others can be identified.

Knowing the properties of an informal learning network within which an individual is embedded will provide for a greater understanding of the individual's learning orientations, actions and outcomes. Rogers and Agarwala-Rogers (1976) have identified several communication roles of individuals within an organization. By understanding the function of individuals in these roles one can also understand the flow of information within a group and the relationship of one group to another.

Rogers defined the gate keeper as an individual who controls the flow of information through a communication channel. Schwartz and Jacobson (1983) described the liaison role as an individual who interacts with two or more separate groups, although the liaison is not a member of either group. Opinion leaders can be described as those individuals who formally influence others attitudes. They are usually members of a group, thus differentiating them from the liaisons. Cosmopolites are those individuals who relate the organization to its environment. Their importance has been seen as providing an openess to the system (Rogers and Agarwala-Rogers, 1976).

Stern, et. al. (1976) described the importance of determining an individual's position in a peer group structure. The more central an individual is to a group the more likely he is to accept an innovation. This description could be compared to the opinion of leader roles. Becker (1970) further described diffusion of innovations in that the individual who is in a central communication position hears about new ideas earlier. This person has greater exposure to information from outside of his group and this information contributes to his being considered an opinion leader by his peer group. Several researchers have utilized network analysis to identify the diffusion of ideas among professional groups. For example, Cervero and Rottet (1984) found that the social system to which an individual belonged influenced his acceptance of a continuing professional education program. Faculty members in a School of Nursing represent members of one such professional organization. Position within the professional network should determine the extent to which an individual participates in professional development activities.

Determining faculty development activities is usually left up to the individual faculty member. When an individual faculty member is a member of a peer group and has connections to other groups by way of liaisons or cosmopolites, diffusion of new ideas is constant. His ability to identify areas of strengths and weaknesses is usually internally governed by his knowledge of the subject matter of the new ideas. However, if the individual is a member of a group which has little contact with other groups or where the opinion leader also acts as a gate-keeper for new ideas, the individual may not be able to identify areas of weakness in light of new innovations. By analyzing the network structure of an organization, informal and formal groups can be identified, the flow of communication can be demonstrated and the roles of the individual members can be determined. The utilization of this data is essential in order to plan for change or improvement within an organization.

Given the importance of professional networks in influencing the behavior of individual professionals, particularly in terms of engaging in professional development activities, the purpose of this study was to analyze the structure in an informal faculty development network in a School of Nursing.

METHODS

Subjects

A Sociometric survey was utilized in this study to identify the informal faculty development network existing withing the School of Nursing at East Tennessee State University. All twenty-nine full-time faculty members in the Baccalaureate Degree and Associate Degree nursing programs were asked to participate in the study. Twenty-five of the faculty members did complete the survey and represent population upon which the analysis is based. The twenty-five faculty members ranged in age from 24 to 56 years with a mean age of 38.4 years. Only two of the twenty-five respondents were male. The average respondent had been employed by East Tennessee State University for 4.56 years. Sixteen of those responding were members of the Department of Baccalaureate Degree Nursing, while nine where from the Department of Associate Degree Nursing.

Instrumentation

During the Fall, 1983, semester, all nursing faculty members were asked to complete the Survey of Social Networks, a self-report instrument that asked faculty members to identify those colleagues from whom they sought advice regarding their role as teacher during the preceeding six months, as well as the number of such contacts initiated per month. In addition, faculty members were provided information pertaining to their own academic background and professional activities, as well as demographic characteristics.[1]

Analysis

The sociometric choices of individual faculty members were entered into rectangular adjacency matrix in which the rows represented the twenty-five faculty members and the columns represented the same set of faculty members in an identical sequence (Knoke and Kuklinski, 1982). The faculty members arranged in the rows of the matrix represented initiators of the specified contacts, while those arrayed across the columns were recipients of the contacts. The elements in the matrix indicated the nature of the linkages between faculty members according to the following format: 1) a zero (0) was entered into the matrix if no contact was specified by either faculty member; 2) a one (1) was entered into the matrix if one of the two faculty members specified a linkage; 3) a two (2) was entered into the matrix if both faculty members indicated that the linkage existed. The variable Zij represents the value of the relationship from the i^{th} faculty member to the j^{th} faculty member. Since the matrix was square, the diagonal (Zii elements) represented

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[1] A copy of the both Survey of Social Networks can be obtained from the authors.

self-linkages and hence were set equal to zero. Figure 1 shows the symmetric matrix representations for the teaching improvement network in the School of Nursing.

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0
3	0	0	0	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
4	0	1	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0
5	0	0	0	0	0	2	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
6	0	0	0	0	2	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0
7	1	0	0	0	1	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0
8	1	0	0	0	1	1	2	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
A	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
B	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	2	0	1	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0
H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	1	1	1	0
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0
J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
K	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	0	1	0	0	0	0
L	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0
M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	2	0	1	0	0
P	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FIGURE 1. TEACHING ASSISTANCE NETWORK IN MATRIX FORMAT

The square symmetric matrix containing the proximities (linkage distances) between members of the nursing faculty were analyzed using the multidimensional scaling program, ALSCAL, available through the Statistical Analysis System (Reinhardt, 1980). ALSCAL provided a picture or spatial representation of the relationships existing between the members of the School of Nursing faculty

members based on the measures of similarity or interaction strength (values 0, 1 or 2). Since the measures of proximity were ordinal in nature, Kruskal's (1964) nonmetric multidimensional scaling method was used to obtain the spatial configuration. A graph of the obtained stress values by number of dimensions was used to determine the appropriate number of dimensions needed to effectively account for the matrix of proximities (Subkoviak, 1975).

Once stimulus coordinates of each faculty member were obtained through the multidimensional scaling procedures and the appropriate dimensionality of the informal structure ascertained, it was necessary to obtain an interpretation for the spatial configuration. Three separate techniques were used in making such an interpretation. Initially, a subjective interpretation of the configuration was obtained as researchers utilized insight based on knowledge of the School of Nursing to describe the spatial configuration, as suggested by Subkoviak (1975).

Cluster analysis was used to group the twenty-five respondents in the initial spatial configuration into homogenous subsets based on the symmetric adjacency matrix using the ADCLUS program available through the Statistical Analysis System (Sarle, 1981). Using this procedure, researchers were able to use knowledge of faculty properties to determine what faculty members within particular clusters had in common and how they differed from faculty members in other clusters. The appropriate number of clusters was determined by plotting R^2 values by the number of clusters in a solution and identifying discontinuities in the attained curve. The ADCLUS procedure allowed researchers to identify individuals who were isolated in the teaching development network and those who served as "bridging agents" by linking two or more clusters of faculty members.

Finally, correlations were calculated between individual positions as dimensional coordinates and several external measures thought to be associated with position within the faculty development network. The two variables most closely associated with each dimension were entered into a stepwise multiple regression equation. The resulting coefficients were used in further interpreting or naming each of the respective dimensions (Shepard, 1972).

RESULTS

Nonmetric Multidimensional Scaling

The initial two dimensional configuration resulting from the nonmetric multidimensional scaling program is shown in Figure 2. The resulting two dimensional configuration provided an inadequate fit between the original proximities and the transformed interpersonal distances. The stress value for the two dimensional solution was .37 and the R^2 was .31. The configuration in three through five dimensions were examined in order to select an appropriate solution. The skree plot of stress values by dimensionality indicated that the four dimensional solution would result in the most interpretable results. The four dimensional solution produced a stress of .19 and an R^2 of .52.

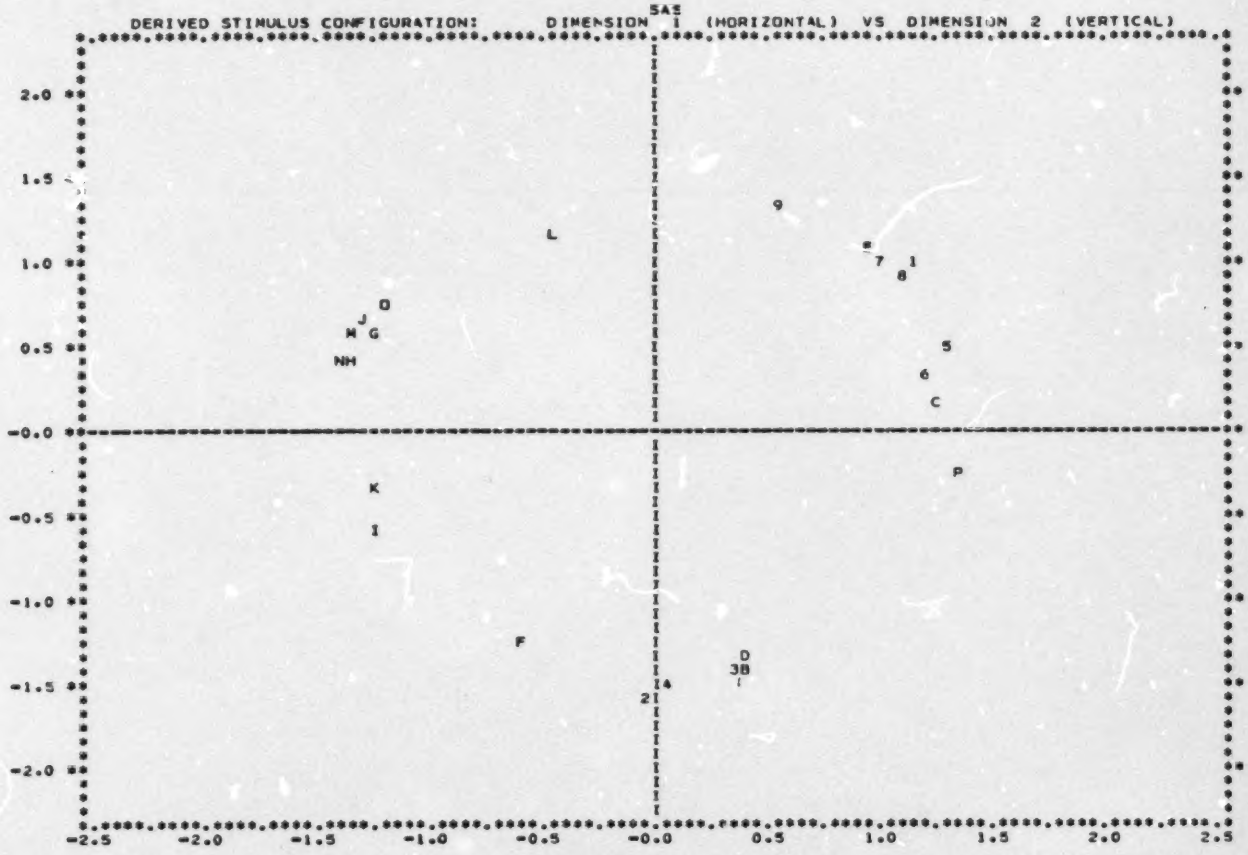

FIGURE 2. IDENTIFICATION OF TEACHING DEVELOPMENT NETWORK IN THE SCHOOL OF NURSING: DIMENSION 1 versus DIMENSION 2.

Subjective Interpretation of the Solution

A visual inspection of the two dimensional plot of the teaching development network indicated the existance of several distinct groupings of faculty members. Perhaps the most obvious finding was the lack of interaction between members of the Associated Degree (AD) and Baccalaureate Degree (BD) programs, with the AD faculty falling at the far left of the plot and the BD faculty lying at the far right. The two dimensional plot also indicated that information sharing regarding the teaching role occurred primarily within the confines of existing clinical teaching teams. There appeared to be a tendency to discuss teaching improvement strategies only with those on one's teaching team, and not other members of the department or school. It also appeared that faculty members with administrative appointments were only loosely connected to any clearly defined teaching development clusters.

Cluster Analysis

A skree plot of R^2 values by the number of identified clusters indicated that the number of empirically derived clusters should be cut off at four. The four clusters identified through the ADCLUS procedure were overlapping. The four clusters, superimposed on the two dimensional MDS solution are shown in Figure 3.

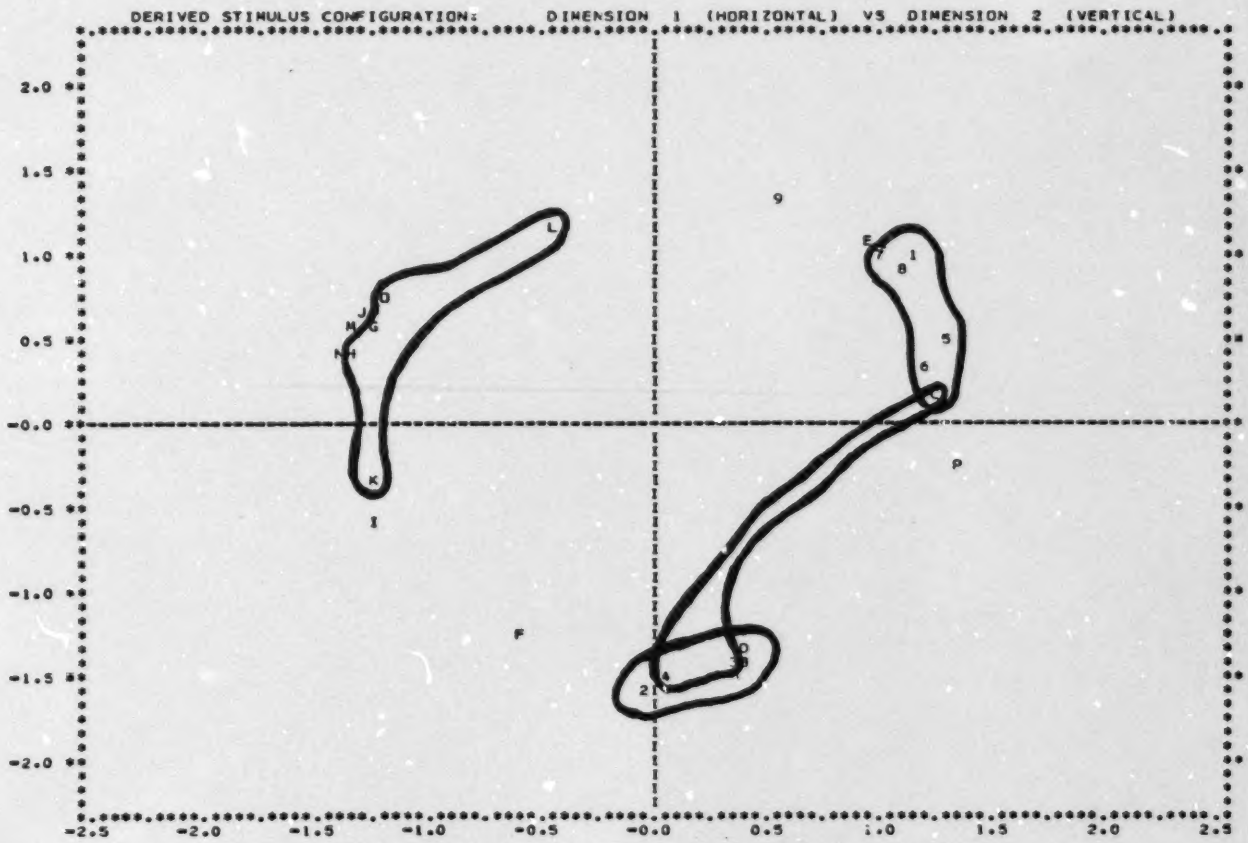

FIGURE 3. IDENTIFICATION OF TEACHING DEVELOPMENT CLUSTERS WITHIN THE TWO-DIMENSIONAL MDS CONFIGURATION.

The cluster analysis served to reinforce the results of the subjective interpretation of the two-dimensional plot. Clearly, there appeared to be very little interaction between members of the AD and BD departments. A possible explanation for this occurance was the fact that the AD department had been located on the main campus for only one year. In addition, the departmental chairmen of both departments had been employed in their positions less than three months. Those who would be classifed as isolates were primarily part-time faculty members.

The two larger clusters in the upper and lower quadrants represent the junior and senior level full-time faculty members of the baccalaureate degree

program. These clusters show a direct correspondence between the formal and informal structure of the department.

The three members of the cluster that links the upper and lower quadrants were members of the curriculum committee. Two of the three were course coordinators. The only communication between the teaching terms appears to be associated with the formal committee structure.

The members of the cluster in the left quadrants were faculty in the Department of Associate Degree Nursing who have a specialty in medical surgical nursing. These faculty did not teach on the same teams. The cluster was comprised of three course coordinators, a veteran faculty member and a new faculty member. There appeared to be little interaction between faculty in the specialty areas (e.g., psychiatry or maternal-child) and the medical surgical faculty--except through the course coordinator.

External Analysis

The correlations found between external variables and dimensions 1-4 are shown in Table 1.

TABLE 1. CORRELATIONS BETWEEN EXTERNAL VARIABLES* AND COORDINATES ON DIMENSIONS ONE THROUGH FOUR.

External Variables	DIMENSIONS Dimension One	Dimension Two	Dimension Three	Dimension Four
AGE	-.09	.07	.37	.07
DEG	.11	-.21	.29	-.32
YHD	-.17	.04	.58	-.06
YHFE	-.06	.01	.37	-.33
YFETSU	-.11	.11	.10	.15
RANK	.19	-.31	.16	-.25
PTA	-.04	-.36	.24	-.19
AP	.13	-.17	.12	.21
PP	-.03	-.25	.36	-.05
OSM	.01	-.12	.29	-.10
BP	.35	.12	.29	.23
MOR	.01	-.07	.29	-.38
UCOM	.03	-.33	.47	-.12
PTT	.10	.13	-.05	.19
PTR	-.03	.00	.37	-.24
PTS	-.05	-.17	.01	.24
TCOS	.15	-.31	.08	.03
RCOS	.02	-.49	-.06	-.03

KEY: AGE = Respondent's Age; DEG = Highest Degree; YHD = Years Since Highest Degree; YFHE = Years a Faculty Member in Higher Edcuation; YFETSU = Years on Faculty at ETSU; RANK = Academic Rank; PTA = Percent of Time in Adminstration; AP = Article Published; PP = Papers Presented; OSM = Out of State Meetings Attended; BP = Books Published; MOR = Monographs or Reports Written; UCOM = University Committees Served On; PTT = Percent Time Spent Teaching; PTR = Percent Time Spent on Research; PTS = Percent Time Spent in Seminars; TCOS = Teaching Cosmopolitanism; RCOS = Research Cosmopolitanism.

Dimension One was most clearly associated with the number of books published during the previous two years (r=.35) and the faculty members rank (r =.19). These external variables were entered into a stepwise multiple regression equation to predict placement on Dimension One.

The resulting model was not statistically significant (α =.05) and only explained 12% of the variance in dimension one coordinates. Thus, the external variables were not effective in labeling Dimension One.

Dimension Two was most closely related to the extent to which an individual interacted with others outside the School of Nursing pertaining to research matters (r=-.49) and the percentage of time spent in administration (r=-.36). Only research cosmopolitanism had a significant effect (α =.05) when the two variables were entered into the regression equation. Research cosmopolitanism explained 24% of the variability along Dimension Two. Dimension Two appears to be related to the extent to which a faculty member is involved discussing research with others within the university.

Placement along Dimension Three was most closely related to the length of time the faculty member had held his or her highest degree (r=.58) and to the number of university committees the faculty member was serving on (r=.47). Both of these variables entered the multiple regression equation. The resulting two variables model was statistically significant (α =.05) and explained 50% of the variability along Dimension Three. Those faculty members who had been out of graduate school the longest and who were serving on the largest number of university committees, clustered at one pole of the continuum, while less experienced members and those not extensively involved in university committee work clustered at the opposite pole.

Position along Dimension Four was most closely associated with the number of monographs and reports written during the previous two years (r=-.38) and the number of years spent as a faculty member in higher education (r=-.33). When entered into the multiple regression equation to predict placement along Dimension Four, resulting two variable model did not reach statistical significance (α =.05) and only explained 14% of the variability in position along Dimension Four. The external variables were not effective in identifying the structure underlying Dimension Four.

Synthesis and Summary

The three analyses of the spatial configuration tended to supplement one another and allow interpretations to be made about the structure of the informal faculty development network at East Tennessee State University. First, it appears that the informal structure was strongly effected by more formalized boundaries within the School of Nursing; i.e., departmental affiliations and committee structure. Associate Degree faculty tended to seek advice from Associate Degree colleagues, while Baccalaureate Degree faculty sought out others within their own department. Interdepartmental exchange did not appear to be common. However, even within departments there appeared to be an absence of information flow between clinical teaching teams with the exception of course coordinators. Part-time or new faculty members were not prominent in the existing teaching development clusters and, in fact, appeared isolated from existing clusters. Linking agents tended to be those

individuals who had a great deal of experience. In addition to group membership based on more formalized characteristics, such as departmental affiliation or terms of employment, the external analysis has also shown that older, more experienced faculty members, who had a greater number of ties to the rest of the university, were more likely to seek advice from one another on a regular basis. Faculty members with less experience tended to serve as sources of information and advice for each other.

Similarly, those who interacted with university colleagues about research matters tended to serve as sources of teaching advice for one another, while those who did not collaborate with university colleagues on research tended to cluster together.

CONCLUSIONS

The results of this study have demonstrated the utility of using multidimensional scaling and cluster analysis techniques to uncover the latent or emergent structure of a faculty development network in a School of Nursing. Several findings from the study can be utilized in designing more effective strategies for bringing about faculty development.

First, it was apparent that little informal sharing of information existed between members of the Associate Degree and Baccalaureate Degree programs. The formal or prescribed networks (departments) appeared to be limiting the amount of development that potentially could be fostered. If interdepartmental exchange is seen as a mechanism for providing individual faculty members with a larger range of faculty development resources, then perhaps formalized mechanisms should be developed which encourage such "cross-fertilization". For example, an interdepartmental teaching development committee might be established or interdepartmental teaching teams might be developed according to clinical specialty areas.

Secondly, new faculty members appeared to linger at the fringes of the faculty development networks and therefore did not have access to suggestions from colleagues. However, these new faculty members may be those who could most benefit from an informal information network. Mechanisms may be needed that embed new faculty members into exisiting faculty development networks more quickly, such as the formation of a "mentor system", in which new faculty members are linked to an experienced faculty member for a specified period of time. A formal orientation program could intiate this linkage.

Thirdly, part-time faculty members appear more likely to act as isolates in the teaching development network. Without having access to the valued information flowing within the faculty development network, one might question whether part-time faculty members have the opportunity to teach as effectively as full-time members. This problem becomes even more serious when one considers that part-time faculty members may be unfamiliar with the departmental curriculum, as it relates to clinical teaching. If this is the case, then the School of Nursing may not only be putting part-time faculty in uncomfortable positions, but subjecting students to a compromised educational experience as well.

Finally, it appears that the principle of homophily is operating, as faculty members select others with whom to interact concerning professional development. Those members who are alike in terms of years since graduate school tend to cluster together, while younger, recent graduates do likewise. Clearly, there is a need to establish ties between these faculty groups. Older, established faculty members have a great deal of experience that could greatly benefit those recently out of college. At the same time, recent graduates may have information and skills that could benefit the veteran faculty members. Perhaps School of Nursing committee membership and teaching assignments should reflect the importance of establishing weak ties between these groups to provide a healthy exchange of old and new ideas.

While network analysis can not provide solutions to all of the problems facing the School of Nursing at East Tennessee State University, it can provide the kind of useful information about group structure and communication flow within the faculty development network that will enlighten decision-making and hopefully identify interventions that can be made in developing a more effective teaching faculty.

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